

REMARKS

Claims 1-17, 21 and 24-25 were previously pending, of which claims 12, 21, and 25 have been amended and claims 26 and 27 added. Reconsideration of presently pending claims 1-17, 21, and 24-27 is respectfully requested in light of the above amendments and the following remarks.

Rejections under 35 U.S.C. § 102 of Claim 25

Claim 25 is again rejected under 35 U.S.C. §102(b) as being anticipated by Tsai et al. (US Patent No. 6,355,558 hereinafter referred to as "Tsai"). As set forth at MPEP §2131, it is well-established:

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.

With respect to the claims as herein amended, this rejection is respectfully traversed.

Claim 25 requires:

A method for improving an interface in a semiconductor device comprising:
forming a first metal layer;
forming a glue layer directly on the first metal layer, wherein the glue layer is an etch stop layer and includes silicon;
performing an inter-treatment on the glue layer to alter upper and lower surfaces of the glue layer for improved adhesiveness wherein the inter-treatment includes using at least one of a plasma and an electron beam; and
forming a second metal layer directly on the altered upper surface of the glue layer.

Claim 25, as amended, requires "forming a second metal layer directly on the altered upper surface of the glue layer." (emphasis added) The Examiner asserts that the second metal layer is disclosed by layer 118. Layer 118 is formed directly on an adhesion promoter layer 112. Thus, it is not formed directly on the altered upper surface

of the glue layer -- asserted by the Examiner to be disclosed by the cap layer 106.

The Examiner also states that Tsai teaches a first layer 104 on which a glue layer 106 is formed. The Examiner continues to state that “the glue layer is an etch stop layer and includes silicon (layer 106 is formed of silicon carbide)...” The Examiner provides no indication of the provisions of Tsai providing that the cap layer 106, argued by the Examiner to disclose a glue layer, is an etch stop layer. Furthermore, in Figs. 1A-1E cited by the Examiner as disclosing claim 25, it is clear that the cap layer 106 is not illustrated as providing an etch stop layer function. See, for example, Fig. 1E.

Furthermore, the Examiner states that the inter-treatment is provided by the surface treatment 108 in Tsai. The surface treatment 108 however clearly provides for a hydrophilic surface 110 illustrated in Fig. 1E as the upper surface. Applicants find no disclosure in the Figures or portions of the specification referenced by the Examiner indicating a lower surface of the glue layer would be affected, as is required by claim 25.

As such, Tsai does not teach all the elements of claim 25. Therefore, the rejection is not supported by the Tsai reference and should be withdrawn.

Rejections under 35 U.S.C. § 103

Claims 12-17, 21, and 24 are rejected under 35 U.S.C. § 103(a) as being unpatentable Lee et al. US Patent 6,472,306 (“Lee”) in view of Tu et al. US Patent 5,962,344 (“Tu”). Claims 1-4 and 6-11 are again rejected under 35 U.S.C. § 103(a) as being unpatentable over Schmitt et al. (US Patent No. 6,913,992, hereinafter “Schmitt”) in view of Tsai. Applicant traverses these rejections on the grounds that these references are defective in establishing a prima facie case of obviousness with respect to the referenced claims.

In *KSR Int’l. Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1739 (2007), the Court stated that “a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. Although common sense directs one to look with care at a patent application that claims as innovation the combination of two known devices according to their established functions, it can be important to identify a reason that would have prompted a person of

ordinary skill in the relevant field to combine the elements in the way the claimed new invention does. This is so because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known.” *Id.* at 1741 (emphasis added).

As the PTO recognizes in MPEP §2142:

... The examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. If the examiner does not produce a *prima facie* case, the applicant is under no obligation to submit evidence of nonobviousness...

In the present application, a *prima facie* case of obviousness does not exist for the claims for the reasons set forth below.

§ 103 Rejection of Independent Claim 12 and 21

Claim 12

The amendments to claim 12 are for ease of readability and unrelated to patentability.

1. The Examiner has not shown that all words in the claim have been considered

MPEP 2143.03 states that “[a]ll words in a claim must be considered in judging the patentability of that claim against the prior art.” Quoting *In re Wilson*, 424 F.2d 1382, 1385 (CCPA 1970). However, in the present matter, the Examiner has not shown that all words in the claim have been considered. For example, claim 12 requires

A method for increasing a dielectric breakdown lifetime of a semiconductor device, the method comprising:
depositing a dielectric layer;
depositing a first metal layer adjacent the dielectric layer;
depositing a glue layer on the dielectric layer and the first metal layer such that an interface is formed directly between the first metal layer and a lower surface of the glue layer and an interface is formed directly between the dielectric layer and a lower surface of the glue layer;
selecting at least one of a plasma treatment process

and an electron beam treatment process;
applying the selected treatment process to affect the
upper and lower surfaces of the glue layer;
forming a second metal layer directly on the upper
surface of the glue layer, wherein the treatment process
enhances an adhesiveness between the dielectric layer and
the second metal layer.

The Examiner asserts that Lee provides all limitations except for teaching a plasma or electron beam treatment process, applying the treatment to affect the upper and lower surfaces of the glue layer, and the treatment enhancing adhesiveness between the dielectric layer and the second metal layer. Instead, the Examiner asserts these limitations are provided by Tu. The Applicants respectfully disagree for at least the following reasons.

As a preliminary matter, the Examiner has cited to a second metal layer being disclosed by Lee in reference number 126. Photoresist plugs 126 do not provide a metal layer. See col. 6, lns. 5-6.

The Examiner refers to Fig. 9 of Lee as providing the pertinent claim limitations. Fig. 9 is reproduced below, for ease of reference. The Examiner asserts that a first metal layer is provided by metal lines 102, a glue layer by sealing layer 104, and a dielectric layer is provided by disclosure of a substrate 100.

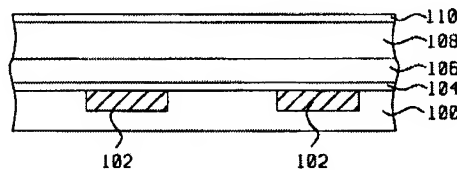


FIG. 9

The Examiner refers to Fig. 5 of Tu as providing the claimed treatment. Fig. 5 is reproduced below for ease of reference. Tu discloses performing a plasma process on a passivation layer 24.

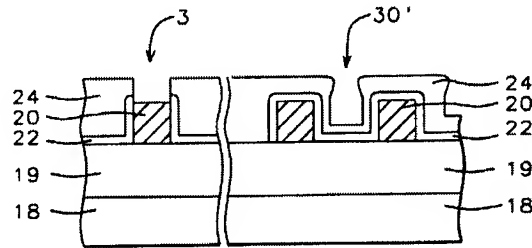


FIG. 5

It is clear that the Examiner has not considered the element of applying at least one of a plasma treatment process and an electron beam treatment process to a glue layer. The Examiner is reminded, for example under MPEP § 2141.02, of the obligation to look at the claims, and the prior art, as a whole. Even assuming, *arguendo* that Tu provides for a treatment including a plasma or electron beam, it does not provide for such a treatment on a glue layer. Tu provides for a plasma treatment of a passivation layer. Specifically, Tu provides for a treatment of layer 24 of Fig. 9. Though silicon nitride may be used as passivation layer, this does not disclose a glue layer. Tu specifically provides the plasma treatment to avoid voids in a passivation layer formed over metal lines (e.g., metal lines 20), as the passivation must fill between metal line structures. See Abstract and Fig. 1 for description of voids. As described below, one skilled in the art would find no reason to combine this process with the structure of Lee, as illustrated in Fig. 9, as the sealing layer 104 (the asserted glue layer) is neither a passivation layer, nor is it provided over a topography that would provide for a risk of the voids recognized by Tu.

The Examiner has also not considered the claimed element of “wherein the treatment process enhances an adhesiveness between the dielectric layer and the second metal layer.” Even assuming, *arguendo*, that the combination of Tu with Lee would provide for treating layer the sealing layer 104 of Lee, this layer does not provide for an enhancement in adhesion between a dielectric layer and a second metal layer as claimed. The Examiner asserts the second metal layer is provided by 126 and the dielectric layer is provided within the substrate 100. As is clear in Fig. 13, the glue layer doesn’t enhance the adhesion between the second metal and a dielectric and the second metal (photoresist plugs 126) is positioned only over the asserted first metal layer 102.

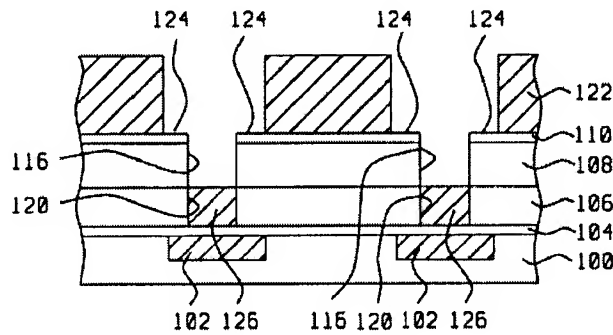


FIG. 13

Thus, for this independent reason alone, the Examiner's burden of factually supporting a *prima facie* case of obviousness has clearly not been met, and the rejection under 35 U.S.C. §103 should be withdrawn.

2. The Examiner has not shown how the elements being combined are performing their known or established function

KSR teaches that when combining elements from different references, it is important to determine whether the element is performing "the same function it had been known to perform." *KSR* at 1740. It is clear that the plasma treatment of Tu should not be combined with the device of Lee because the known function of plasma treatment is changed. More particularly, Tu provides a method of fabricating an improved silicon nitride passivation layer over closely spaced metal lines used for metal electrical interconnections. Col. 3, lns. 41-44. The method is performed to eliminate "keyhole formation" (voids) in the passivation layer between the closely spaced metal lines. Col. 2, lns. 37-39. Another object of Tu is to densify the silicon nitride to reduce the pinholes in the passivation to reduce failures of the pinhole test (a passivation reliability test). Col. 2, lns. 41-45. The proposed modification of the Tu patent clearly destroys the purpose or function of the invention disclosed in the patent, as the Lee device, and in particular the sealing layer 104 is not a passivation layer and would not suffer from the voiding issues remedied by Tu. The sealing layer 104 is not provided over closely spaced interconnect lines, or such similar topography. See Fig. 9 reproduced above. The sealing layer 104 is applied as a conformal coating on a substantially planar surface of the substrate 100. See

Fig. 9. Thus, one of ordinary skill in the art would not have found a reason to make the claimed modification.

Thus, for this reason alone, the Examiner's burden of factually supporting a *prima facie* case of obviousness has clearly not been met, and the rejection under 35 U.S.C. §103 should be withdrawn.

3. The Examiner has not shown how the elements being combined produce a predictable result

MPEP 2143.01 (III) states that the "mere fact that references can be combined does not render the resultant combination obvious unless the results would have been predictable to one of ordinary skill in the art." In the present case, the Examiner has not expressed any reason why combine the plasma treatment of Tu with the device of Lee in the way the claimed would present a predictable result. The Examiner states that the combination is obvious "in order to minimize the problem of keyhole formation in the layer." Office action, page 7. However, this is simply inaccurate. One skilled in the art would not recognize such an issue in Lee as the sealing layer 104, asserted to the layer on which the plasma treatment would be applied, is formed on a substantially planar substrate and would not suffer from the voiding issues explained by Tu as occurring when conformally filling spaces between closely adjacent metal lines.

Thus, for this reason alone, the Examiner's burden of factually supporting a *prima facie* case of obviousness has clearly not been met, and the rejection under 35 U.S.C. §103 should be withdrawn.

Claim 21

For reasons substantially similar to as addressed above with reference to claim 12, claim 21 is also deemed allowable. Claim 21 requires, in part:

... a first interface is formed directly between metal of the first metal layer and a lower surface of the glue layer and a second interface is formed directly between the dielectric layer and a lower surface of the glue layer; performing an inter-treatment on the glue layer... a third interface is formed directly between metal of the second metal layer and the upper surface of the glue layer, and wherein the

third interface overlies the first interface and second interface. (emphasis added)

Additionally, and independently, the Examiner has also not considered the limitation that that the third interface (second metal and upper glue) overlies the first (first metal and lower glue) and second (dielectric and lower glue) interfaces. Lee illustrates an interface between a second metal and glue layer over lying an interface between a first metal and glue layer, but does not provide an interface between a second metal and glue layer overlying an interface between a dielectric and the glue layer as claimed. See the above discussion of improving adhesion between the second metal layer and the dielectric layer and Fig. 13 of Lee. For at least this additional reason, claim 21 is allowable.

§ 103 Rejection of Independent Claim 1

- 1. The Examiner has not shown that all words in the claim have been considered;**

The Examiner has not shown how the elements being combined are performing their known or established function

KSR teaches that when combining elements from different references, it is important to determine whether the element is performing “the same function it had been known to perform.” *KSR* at 1740. The Examiner’s proposed combination of Schmitt and Tsai simply does not recognize the functions that layers are performing in each device. The Examiner rearranges the structures in a manner in hopes to read upon the claim, but the resulting structure neither performs the function, nor would be predictable to one skilled in the art.

For example, the Examiner identifies layer 110 of Schmitt as the first layer, and then admits that this is not a metal layer as required by the claims. In contrast, layer 110 is disclosed by Schmitt as a dielectric layer. See col.12, ln. 35. One skilled in the art would readily recognize this layer can not be a metal layer regardless of the combination as it would destroy the purpose of the device Schmitt and the copper 126 (i.e., the dual damascene interconnect structure). The dielectric layer 110 provides isolation for the contact/via structure 116. Providing metal in lieu of the dielectric layer 110 would provide electrical contact (e.g., causing a short) to the contact/via structure 116 thus destroying the functionality of the dual damascene formed interconnect.

The Examiner asserts that Tsai illustrates a first metal layer (104) underlying a second metal layer (118). Tsai discloses a dual damascene structure (e.g., 118) above a dual damascene structure (e.g., 104). Between these structures are a cap layer 106 and an adhesion promoter layer 112. Schmitt discloses a single damascene structure (e.g., including 126). If one were to combine the devices of Tsai and Schmitt as proposed by the Examiner, it would form two “layers” (e.g., two “metal layers” as referred to in the art) of dual damascene structures. In other words, a second layer would be formed on the structure of Fig. 2H of Schmitt. In doing so, the combined structure in no manner provides for the etch stop layer 114 (asserted by the Examiner to provide a glue layer) to be between a first metal layer and a second metal layer. The etch stop layer 114 would continue to be placed above the dielectric 110 and used to form each single dual damascene structure. As the claim limitations require the glue to be formed directly on the first metal layer, and a second metal layer to be formed directly on a glue layer, these limitations can not be provided by the combined structure.

Furthermore, the asserted glue layer, the etch stop layer 114, has an interlayer adhesion layer 115 formed directly on it. Not a second metal layer as claimed. Similarly the cap layer 106 of Tsai has an adhesion promotion layer 112 formed on it, not a second metal layer. Further still, any assertion by the Examiner that the etch stop layer 114 of Schmitt would be provided between dual damascene structures such as 104 and 118 of Tsai is improper as the function of an etch stop layer is entirely lacking in this configuration. Therefore, Applicants find lacking in the Examiner’s combination of references any consideration of the glue layer being formed directly on a first metal layer and a second metal layer formed directly upon the glue layer. Furthermore, the Applicants argue that the Examiner is not properly considering the known function of each element of the references in his hypothetical combination. For at least these reasons, claim 1 is allowable.

Dependent Claims

Dependent claims 2-11, 13-17, 24, and 26-27 depend from and further limit independent claims 1, 12, 21, and 25 respectively and therefore are deemed to be patentable over the prior art.

Conclusion

An early formal notice of allowance of claims 1-17, 21, and 24-27 is requested. The Examiner is invited to telephone the undersigned if further assistance is necessary.

Respectfully submitted,



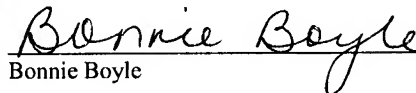
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